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# Chitinozoan Faunule of the Devonian Cedar Valley Formation

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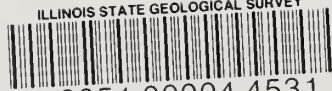
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**CHITINOZOAN FAUNULE  
OF THE DEVONIAN  
CEDAR VALLEY FORMATION**



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# CHITINOZOAN FAUNULE OF THE DEVONIAN CEDAR VALLEY FORMATION

Charles Collinson and Alan J. Scott

## ABSTRACT

The Chitinozoan faunule of the upper Middle Devonian Cedar Valley formation from a single outcrop in northwestern Illinois is described. The faunule, which is abundant and diversified, represents more than thirteen species referable to four genera. One new genus, *Earlachitina*, and eight new species are described and named.

The faunule is distinct from the previously described Devonian Clear Creek, Bailey, and Grand Tower faunules of Illinois and Indiana, but has elements in common with Devonian faunules from Brazil and Germany.

The technique of collecting and preparing chitinozoan specimens from limestone is discussed.

## INTRODUCTION

In 1955, as part of a summary of the distribution of Chitinozoa, Collinson and Schwalb listed 20 occurrences of these microfossils in North America. Among them were three distinct faunules of Devonian age - one from the Clear Creek formation as represented in samples from a number of wells in the Illinois basin, another from the Bailey formation in southern Illinois and western Indiana, and a third from the Grand Tower formation in both eastern and western Illinois.

Shortly after the Collinson and Schwalb (1955) report was published, a fourth Devonian chitinozoan faunule was discovered in the Cedar Valley limestone in northwestern Illinois. This faunule, which is remarkably abundant and diversified, represents the youngest known occurrence of chitinozoans. In general aspect, it is quite different from other Devonian faunules and contains important elements never before described.

The Cedar Valley faunule therefore is of special interest for it seems to indicate that chitinozoan species evolved rapidly enough to make them useful for detailed zonation whenever adequate data are assembled. That chitinozoan species have considerable lateral distribution independent of facies changes has already been established by study of the Clear Creek faunule. The great numbers encountered in the Cedar Valley faunule and the ease in collecting and processing them also lends encouragement for their stratigraphic use.

Because the Cedar Valley chitinozoans are variable both in form and preservation, we have illustrated as many examples as possible (pls. 1-3). Lest this be confusing, we have also included text figures showing our interpretation of an average representative of many species. The plate illustrations are camera lucida

drawings made in pencil on coquille drawing board by the authors. Most of the stippled text figures were made by Marie Litterer. Howard Schwalb did much of the processing and mounting of samples and Romaine Skartvedt made invaluable translations of foreign literature. For their help we are indeed grateful.

The terminology used in this report is that of Collinson and Schwalb (1955, text fig. 4) although we have also adopted use of the term "apical angle" (Öffnungswinkel) as applied by Eisenack (1955a, p. 163) to the imaginary vertex angle of subconical body chambers as found in such genera as *Sphaerochitina* and *Ancyrochitina* (text fig. 8). We have further found the application of such ratios as "neck length/over-all length" and "maximum diameter/over-all length" useful in describing some species. Determination of these ratios is clarified in text fig. 2.

### LABORATORY TECHNIQUES

The procedure used to prepare chitinozoans for study is sufficiently different from methods employed in research on foraminifera, ostracodes, and conodonts that a summary of technique merits description here.

Because the matrix of the Cedar Valley is an argillaceous limestone and chitinozoans are insoluble in all the well known acids (HCl, HF, and acetic acid), the samples were first crushed and dissolved in acid. The first few samples were dissolved in 20 percent hydrochloric acid but a well preserved conodont faunule was discovered and the remainder of the samples were dissolved in 10 percent acetic acid, so that conodonts could be recovered along with the chitinozoans.

Because chitinozoans are quite small (0.1 to 0.5 mm. long) and bear delicate structures such as spines and collars, the insoluble residues were not sieved. Instead, in order to concentrate the specimens and eliminate much of the clay-sized material, a thin suspension was made of the insolubles in water, and the suspension was poured into Petri dishes to settle. The chitinozoans settle much more rapidly than the clay and after 30 seconds the clay suspension was decanted, leaving a thin layer of coarser material rich in chitinozoans in the bottom of the dish. Water was then added and the chitinozoans picked from the bottom with the aid of a finely drawn glass pipette.

Specimens were placed on microslides by blowing gently on the open end of the pipette. In this manner the specimens are kept in water suspension until after they are placed on the slide so that the most fragile specimens may be casually moved without breakage. Upon drying, the specimens adhere to the slide without use of cement and are cemented only after they have been studied and illustrated.

### STRATIGRAPHIC AND GEOGRAPHIC OCCURRENCE

The Cedar Valley faunule was discovered during a systematic search for chitinozoans. A series of 500- to 1000-gram composite samples (text fig. 1) were collected from the Milan stone quarry, about half a mile southeast of Milan in northwestern Illinois. The site is near the southeastern edge of the Devonian outcrop

belt which extends nearly across the state of Iowa in a northeastward direction and continues only a short distance into northwestern Illinois.

Both the Cedar Valley and Wapsipinicon formations are well exposed, but sampling revealed that chitinozoans are restricted to the Cedar Valley. The specimens were obtained from a fossiliferous, gray to greenish-gray, fine-grained, argillaceous limestone representing the middle part of the Solon member of the Cedar Valley formation. Text fig. 1 illustrates stratigraphic distribution of the chitinozoans. The microfossils were common in samples 7 and 8 and were abundant in samples 3 through 6.

Species in the faunule are not uniformly distributed throughout the section. With the exception of *Angochitina* n. sp., which occurs only in bed five, all species, most in their greatest numbers, are present in bed three. In beds four through eight, as well as three, *Angochitina milanensis*, *Angochitina devonica*, and *Angochitina mourai* occur abundantly, but representatives of most other species become less numerous as one goes down in the section. Most do not occur below bed six. *Ancyrochitina cornigera* and *Sphaerochitina nodulosa* occur only in bed three but both in considerable numbers. A number of other geographic occurrences of this faunule must be studied before we will know whether the distribution of these species within the zone of occurrence has any stratigraphic significance.

#### FAUNAL SUMMARY

The science of describing and interpreting Devonian chitinozoans is barely in infancy so it is not surprising that each new stratigraphic occurrence produces new and previously unknown forms. For example, of the four genera found in the Cedar Valley, one is new; and of the fourteen or more species in the faunule, only two have been described. The species found in the Cedar Valley are as follows:

- Angochitina globosa* n. sp.
- A. milanensis* n. sp.
- A. devonica* Eisenack
- A. cf. A. devonica* Eisenack
- A. mourai* Lange
- A. n. sp.*
- Ancyrochitina cornigera* n. sp.
- A. megastyla* n. sp.
- Sphaerochitina pilosa* n. sp.
- S. schwalbi* n. sp.
- S. nodulosa* n. sp.
- S. cf. S. nodulosa* n. sp.
- Earylachitina latipes*, n. gen., n. sp.
- E. spp.*

Of the above species, three, *Angochitina milanensis*, *A. devonica*, and *Sphaerochitina pilosa* occur in great numbers and can be found consistently even in small samples. Less abundant, but nevertheless common, are such species as

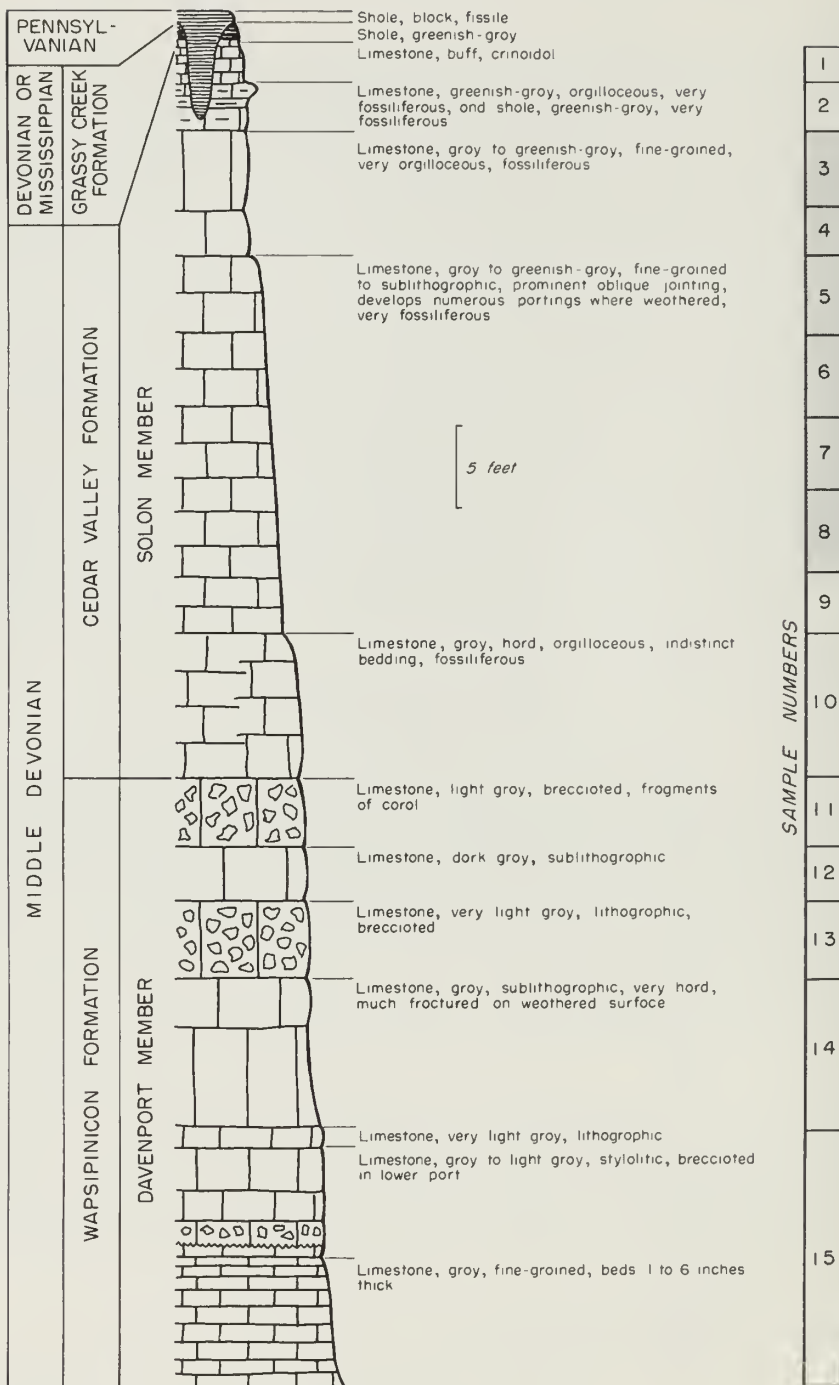


Fig. 1 - Diagram showing stratigraphic section exposed at Milan Quarry, E $\frac{1}{2}$  NW $\frac{1}{4}$  sec. 25, T. 17 N., R. 2 W., Rock Island Co., Illinois (Milan Quadrangle). Shaded sample numbers represent intervals which yield chitinozoans.

*Angochitina globosa*, *Sphaerochitina schwalbi*, and *S. nodulosa*. The general aspect of the faunule in any given sample is therefore determined by these species and is one of flask-shaped forms with multibranching spines in about equal numbers with simple-spined conical forms.

The most diagnostic species in the faunule, rather uncommon although by no means rare, are *Ancyrochitina megastyla* and *Earlachitina latipes*, both of which are unlike anything known from other Devonian faunas.

One important characteristic of the Cedar Valley faunule is its great variability within species, for it is difficult to find more than two or three specimens that are nearly identical. In addition to this variability, specimens are generally distorted and incomplete. Most commonly they are laterally compressed and partly or completely denuded of spines. Clay or sand particles commonly cling to specimens and can be removed only at risk of destroying the specimen. As a result, we have illustrated many specimens with foreign particles attached and have attempted to give an example of each kind of variation and preservation.

#### COMPARISON WITH RELATED FAUNAS

Only two other North American Devonian chitinozoan faunules are known with any degree of completeness. They are the lower Middle Devonian Clear Creek faunule described by Collinson and Schwalb (1955) and the lower Lower Devonian Bailey faunule described in the same study. Both occur in Illinois and Indiana.

The Clear Creek fauna is very well known and has been recorded from more than a dozen localities and wells. It contains:

*Lagenochitina brevicervicata* Collinson and Schwalb

*L. elongata* Collinson and Schwalb

*L. sphaerica* Collinson and Schwalb

*Angochitina flasca* Collinson and Schwalb

*A. pusilla* Collinson and Schwalb

The faunule is undiversified and is characterized by large, heavy-walled representatives of *Lagenochitina* that are present in great abundance. The forms belonging in *Angochitina* are like *Lagenochitina*, differing mainly in possessing spines. The Cedar Valley and Clear Creek faunules are therefore different both in species and in general aspect, there being no similar species between them.

The Bailey faunule is not completely known, but it differs markedly from both of the above faunules. The Bailey species are:

*Lagenochitina sacculus* Collinson and Schwalb

*L. sphaerica* Collinson and Schwalb

*Angochitina bifurcata* Collinson and Schwalb

*Desmochitina poculum* Collinson and Schwalb

*D. sp.*

An important element in the Bailey faunule, *L. sphaerica*, is also one of the most abundant forms found in the Clear Creek. The other representative of

*Lagenochitina*, *L. sacculus*, is quite similar to Clear Creek forms. The remaining Bailey species have no counterparts in the Clear Creek, but *Angochitina bifurcata* is similar to the flask-shaped representatives of *Angochitina* from the Cedar Valley. *Desmochitina* is an element that is known from only one other Devonian fauna, that of the Barreirinha shale of Brazil. However, more than a dozen species of this genus have been reported in Ordovician and Silurian faunas of Europe.

The middle Middle Devonian Grand Tower formation of Illinois contains only one species, *Angochitina bifurcata*, which, as stated above, is closely related to Cedar Valley representatives of *Angochitina*.

In addition to these North American faunas, chitinozoans have been described from the Lower Devonian Ponta Grossa shale (Lange, 1949) and the Middle Devonian Barreirinha shale (Lange, 1952), both of southern Brazil, as well as the lower Middle Devonian Rommersheimer beds of central-western Germany. The Ponta Grossa faunule consists of a single species, *Conochitina biconstricta* Lange, which is not similar to any North American form. The Barreirinha shale fauna consists of three species, *Lagenochitina avelinoi* Lange, *Desmochitina sommeri* Lange and *Angochitina mourai* Lange. The last species occurs in the Cedar Valley but is uncommon. *Angochitina devonica* Eisenack, the single species described by Eisenack (1955, b) from the Rommersheimer beds, is abundant and well preserved in the Cedar Valley faunule.

#### ASSOCIATED FAUNA

A large number of fossils are found associated with the chitinozoans and these, considered along with the lithology of the containing rock, shed some light on the environment in which the chitinozoans lived. The associated fauna follows:

##### COELENTERATES

- Coenites iowensis* (Owen)
- Striatopora rugosa* (Rominger)

##### BRACHIOPODS

- Protileptostrophia perplana* (Conrad)
- Stropheodonta demissa* (Conrad)
- Chonetes scitulus* Hall
- Atrypa reticularis* (Linnaeus)
- Cyrtina umbonata* (Hall)
- Tylothyris subvaricosa* (Hall and Whitfield)
- Spirifer euryteines* Owen
- Spirifer iowensis* Owen
- Eosyringothyris aspera* (Hall)

##### MOLLUSKS

- Gomphoceras* sp.

##### ANNELIDS

- Scolecodont* spp.

## ECHINODERMS

*Megistrocrinus latus* Hall

## CONODONTS

*Acodina?* sp.*Ozarkodina* spp.*Hindeodella* spp.*Polygnathus* spp.*Icriodus* spp.

## INCERTAE SEDIS

*Hystrichosphaeridium* spp.*Micrhystridium* sp.

Of these fossils only a few, corals, crinoids, scolecodonts, and hystrichosphaerids, have environmental significance. The corals and crinoids indicate that the sea was warm, shallow, and well aerated. The scolecodonts reinforce the suggestion of shallow water and the hystrichosphaerids point to near shore deposition. As the corals indicate well circulated water, the lime mud lithology must be explained by the interpretation that little sediment was coming from the relatively nearby shore.

## SYSTEMATIC PALEONTOLOGY

Genus *ANGOCHITINA* Eisenack, 1931Type Species: *Angochitina echinata* Eisenack

The genus contains flask-shaped forms with spines. The type species is from the Silurian Beyrichienkalk of the Baltic region.

ANGOCHITINA MILANENSIS, Collinson and Scott, n. sp.

Plate 1, figures 1-5, 7, 8, 19, 26

This species, along with *Angochitina devonica* and *Sphaerochitina pilosa*, is the most abundant form found in the Cedar Valley faunule. It is characterized by an ovoid body chamber and a distinct, relatively short neck (text fig. 2). The ratio of length of neck, including collar, to over-all length ranges from 0.26 to 0.39 but the average ratio is about 0.33. The ratio of maximum diameter to over-all length is approximately 0.5. Ornamentation of the test consists of spines that may be bifurcate, multibranched, broad-based, or any combination of these. Most specimens have a mixture of long and short bifurcate spines including one or two multibranched and/or broad-based ones. The longer bifurcate spines may range up to 1/5 the diameter of the test. The broad-based spines generally are translucent, being long and thin in cross section.

*Remarks.* - *Angochitina milanensis* is very closely related to *Angochitina devonica* Eisenack, and as both species are variable, transitional forms may occur (text fig. 3). However, the neck serves to differentiate them, *milanensis* having a

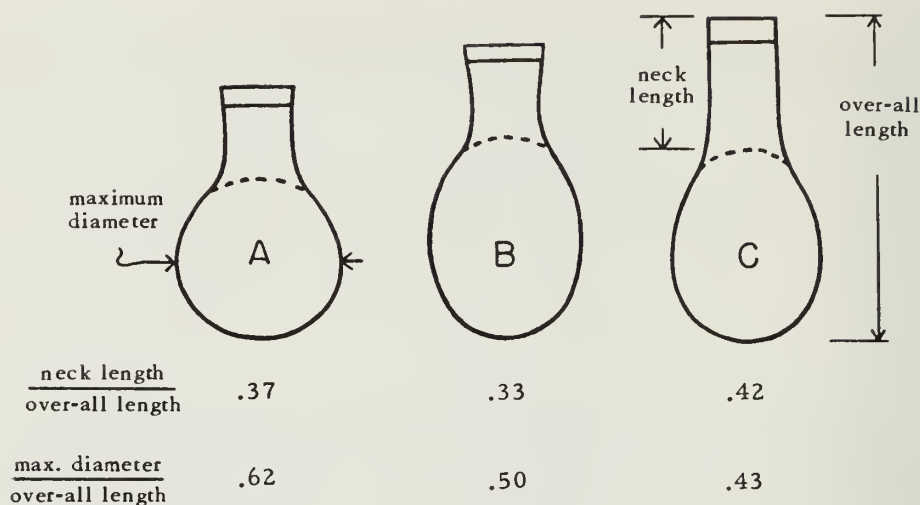


Fig. 2 - Simplified outline diagrams illustrating application of ratios for differentiation of (A) *Angochitina globosa* n. sp., (B) *Angochitina milanensis* n. sp., and (C) *Angochitina devonica* n. sp.

relatively short, distinct neck, and *devonica* a long, tapered, commonly indistinct neck. The ratio of over-all length of neck, including collar, is less than 0.40 in *milanensis* but is greater than 0.40 in *devonica*. *Angochitina milanensis* is also much like *Angochitina bifurcata* Collinson and Schwalb, but the latter bears only fine bifid spines and has a relatively long, narrow collar.

*Measurements.* - The following table represents dimensions in millimeters of eight well-preserved specimens chosen at random, plus the holotype and a paratype. Measurements were made with a micrometer ocular.

| Specimen no.                  | 8P11-23 | 8P11-43 | 8P24-1 | 8P11-29b | 8P11-44 | 8P24-12a | 8P24-12b | 8P24-28 | 8P14a• | 8P14-23* | Mean |
|-------------------------------|---------|---------|--------|----------|---------|----------|----------|---------|--------|----------|------|
| Over-all length               | .140    | .163    | .222   | .172     | .213    | .168     | .163     | .159    | .168   | .163     | .178 |
| Body chamber length           | .127    | .118    | .145   | .109     | .136    | .118     | .109     | .095    | .109   | .104     | .117 |
| Neck length (w. collar)       | .063    | .045    | .077   | .063     | .077    | .050     | .054     | .054    | .063   | .054     | .060 |
| Collar length                 | .009    | --      | .018   | --       | .022    | .013     | .013     | .009    | .009   | .009     | .014 |
| Maximum spine length          | .036    | .022    | .031   | .013     | --      | .013     | .018     | .022    | .020   | .027     | .022 |
| Body chamber width            | .118    | .090    | .109   | .090     | .100    | .077     | .100     | .100    | .100   | .086     | .097 |
| Neck width (average)          | .050    | .045    | .045   | .036     | .054    | .036     | .045     | .050    | .045   | .036     | .044 |
| neck length / over-all length | .33     | .28     | .36    | .37      | .36     | .30      | .30      | .34     | .37    | .30      | .33  |

\* = holotype, • = paratype, -- = not measurable.

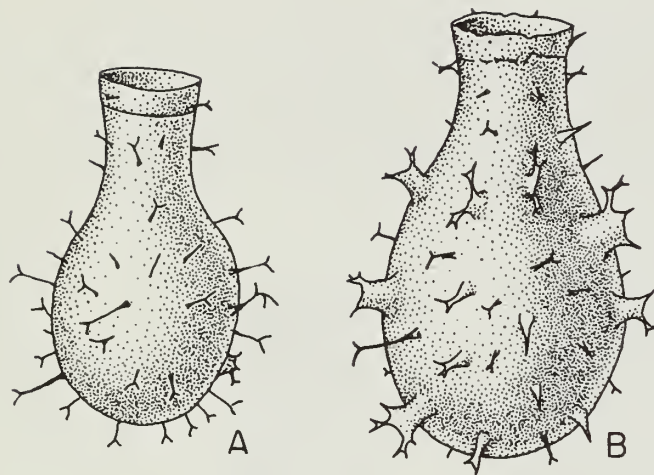


Fig. 3 - Diagrammatic representations of *Angochitina milanensis* n. sp. (A) Specimen showing characteristic shape and spine combination. (B) Variant showing unusual number of broad-based spines and indistinct neck, both  $\times 250$ .

*Derivation of name.* - Named for Milan, Illinois.

*Occurrence.* - Common in beds three through eight, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P14-23 (holotype), 8P14a, 8P24-1, 8P13-3, 8P12-32, 8P25-30, 8P2-25, 8P6, 8P1-22 (all paratypes).

#### ANGOCHITINA DEVONICA Eisenack

Plate 1, figures 6, 9, 10, 14, 18, 20, 21, 24; Plate 3, figures 22, 26

*Angochitina devonica* EISENACK, 1955, *Senckenbergiana lethaea*, band 36, p. 313, pl. 1, figs. 10-12.

*Translation of original description:* - Lower part [neck] nearly cylindrical about one-half to two-fifths of the total length, provided with scarce and usually unbranched, occasionally very long spines; upper part [body chamber] flask-shaped, possessing more or less numerous, simple to well branched, partly antler-like and often very bizarrely formed spines, which can be disproportionately broad at the base. The mouth is evenly truncated, yet nearby spines may extend beyond it.

*Remarks.* - Specimens referable to this species are common in almost all samples of the Cedar Valley limestone examined in this study. Considerable variation in shape was noted (text fig. 4), ranging from forms with fairly distinct necks (such as in the holotype) to individuals (for example, pl. 1, fig. 24) that have very indistinct necks. The ratio of length of neck to over-all length of specimen ranges

from 0.40 to more than 0.46 so it falls within the limits defined by Eisenack. The average over-all length of our specimens is about 0.200 mm. with the smallest measuring 0.163 mm., whereas the holotype measures only 0.146 mm. and Eisenack's largest paratype 0.152 mm. in length. Although there is more than a ten percent difference between our smallest measured specimen and the holotype, we feel that the similarity in shape and proportion greatly outweighs the difference in size.

*Angochitina devonica* is similar to *Angochitina bifurcata* Collinson and Schwalb, the latter having a much longer collar and finer narrow-based bifurcate spines and lacking the broad-based, very irregularly branched spines that are so characteristic of *devonica*. The number and relative density of spines is quite variable in *devonica*, and specimens almost completely covered with spines (pl. 1, fig. 24) as well as those bearing relatively few spines (pl. 1, fig. 14) have been referred to this species. The relationship of *devonica* to *milanensis* has already been discussed in detail.

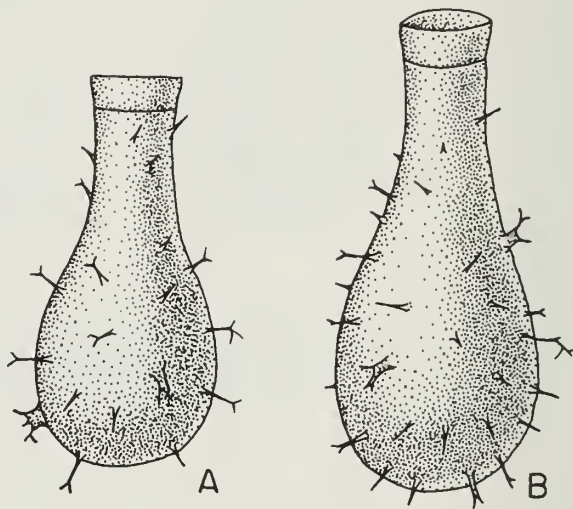


Fig. 4 - *Angochitina devonica* Eisenack. (A) Common body form bearing characteristic spine combination. (B) Large elongate variant with tapered neck. This form is relatively common in our collections. Both  $\times 250$ .

**Measurements.** - The following table shows dimensions in millimeters of nine well preserved specimens chosen at random, plus two representative figured specimens. Measurements were made with a micrometer ocular.

| Specimen no.            | 8P11-10 | 8P11-29a | 8P1-44a | 8P11-23a | 8P11-21a* | 8P11-21b | 8P14-12 | 8P11-47 | 8P11-48a* | 8P-7a* | 8P25-12 | Mean |
|-------------------------|---------|----------|---------|----------|-----------|----------|---------|---------|-----------|--------|---------|------|
| Over-all length         | .254    | .181     | .209    | .209     | .218      | .190     | .190    | .163    | .181      | .200   | .204    | .200 |
| Body chamber length     | .136    | .109     | .109    | .118     | .127      | .109     | .109    | .090    | .109      | .118   | .122    | .114 |
| Neck length (w. collar) | .118    | .072     | .100    | .090     | .090      | .081     | .081    | .072    | .072      | .081   | .080    | .085 |
| Collar length           | .022    | .027     | .018    | .015     | .018      | .018     | .018    | .009    | .013      | --     | .022    | .018 |
| Maximum spine length    | .022    | .018     | .013    | .018     | .031      | .036     | --      | .027    | .009      | .018   | .022    | .021 |
| Body chamber width      | .127    | .090     | .095    | .104     | .109      | .109     | .090    | .077    | .081      | .100   | .090    | .097 |
| Neck width (average)    | .063    | .040     | .036    | .045     | .054      | .045     | .045    | .045    | .040      | .045   | .050    | .046 |
| neck length             | .46     | .40      | .48     | .43      | .42       | .43      | .43     | .44     | .40       | .43    | .40     | .43  |
| over-all length         |         |          |         |          |           |          |         |         |           |        |         |      |

\* = figured specimens, -- = not measurable.

*Occurrence.* - Common in beds three through eight, Solon member, Cedar Valley formation, near Milan, Illinois. Also reported from the lower Middle Devonian, Lower Rommersheimer beds ("Lepidocentrus marl") of the Gerolstein basin in the province of Rheinland Pfalz, western Germany.

*Repository.* - Illinois State Geological Survey, 8P7a, 8P25-12, 8P1-2, 8P11-48, 8P2-26, 8P18-5, 8P1-44, 8P11-21a, 8P11-10, 8P10-43, 8P57-5, as well as specimens listed in table of measurements.

### ANGOCHITINA cf. A. DEVONICA Eisenack

Plate 1, figures 15, 17

Several specimens in our collections are fairly close to *Angochitina devonica* Eisenack but are more slender and tapered (text fig. 5). Most possess scattered simple spines or spine bases, have indistinct necks, and appear to lack collars. Preservation is in general rather poor. The largest diameter is very near the aboral end, tapering to the mouth without interruption. This shape is very similar to that of the genus *Conochitina*.

*Occurrence.* - Uncommon in beds three and five, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P2-26, 8P18-5, (figured specimens).

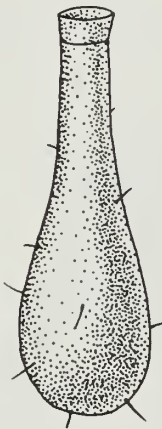


Fig. 5 - *Angochitina* cf. *A. devonica* Eisenack. Tapered form with indistinct neck,  $\times 200$ .

### ANGOCHITINA GLOBOSA, Collinson and Scott, n. sp.

Plate 1, figures 11, 13, 22, 23, 25

*Angochitina globosa* is characterized by a globular body chamber with relatively long bifurcate spines and a neck of variable length terminated by a short collar (text fig. 6). The ratio of length of neck, including collar, to over-all length ranges from 0.31 to 0.43. The spines ornamenting the surface of the test are predominantly coarse, relatively long, (up to  $1/5$  of the test diameter) and bifurcate, but a mixture of both short and long spines is generally present.

*Remarks.* - *Angochitina globosa* is closely related to *Angochitina mourai* Lange, differing only in its larger size, slightly shorter neck, and possession of long, coarse, bifurcate spines rather than the numerous, fine, simple spines of the latter. *A. globosa* is variable so that a few specimens approach the shape of some variants of *Angochitina milanensis*. *Angochitina echinata*, the type species of the genus, is similar to *globosa*, but *echinata* has a much longer neck and unbranched spines.

*Measurements.* - The following measurements made with a micrometer ocular represent dimensions in millimeters of well preserved specimens chosen at random.

| Specimen no.            | 8P11-52 | 8P1-23* | 8P13-1 | 8P13-27 | 8P13-9 | 8P15-2 | 8P12-30b | 8P12-46 | 8P12-1 | 8P20-1* | Mean |
|-------------------------|---------|---------|--------|---------|--------|--------|----------|---------|--------|---------|------|
| Dimensions              |         |         |        |         |        |        |          |         |        |         |      |
| Over-all length         | .181    | .141    | .145   | .163    | .127   | .122   | .136     | .181    | .154   | .163    | .151 |
| Body chamber length     | .109    | .090    | .090   | .109    | .072   | .086   | .081     | .109    | .100   | .100    | .095 |
| Neck length (w. collar) | .072    | .050    | .054   | .049    | .054   | .036   | .054     | .072    | .054   | .063    | .056 |
| Collar length           | .014    | .018    | .018   | .013    | .013   | .018   | .022     | .018    | .018   | .013    | .017 |
| Maximum spine length    | .016    | .014    | .018   | .027    | --     | .027   | .022     | .013    | .022   | .018    | .020 |
| Body chamber width      | .109    | .095    | .090   | .109    | .081   | .090   | .104     | .109    | .095   | .127    | .101 |
| Neck width (average)    | .043    | .036    | .040   | .045    | .043   | .040   | .043     | .048    | .040   | .040    | .042 |
| neck length             | .39     | .35     | .37    | .30     | .42    | .29    | .39      | .39     | .35    | .38     | .36  |
| over-all length         |         |         |        |         |        |        |          |         |        |         |      |

\* = paratype, • = holotype, -- = not measurable.

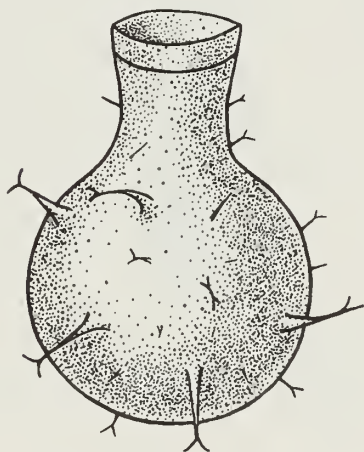


Fig. 6 - Diagrammatic representation of *Angochitina globosa* n. sp., illustrating globular test and characteristic spines,  $\times 330$ .

*Derivation of name.* - From Latin *globosus* meaning "globose."

*Occurrence.* - Common in beds five and six and uncommon in beds three and four, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P1-23 (holotype), 8P1-22, 8P20-1, 8P13-2, 8P25-7, and specimens given in table of measurement (all paratypes).

#### ANGOCHITINA MOURAI Lange

Plate 1, figure 16; plate 3, figure 11

*Angochitina mourai* LANGE, 1952, *Dusenja*, v. 3, p. 377-379, pl. 18, figs. 7-9; pl. 19, figs. 10-12.

*Translation of original description:* - These microfossils exhibit a body in the shape of a globe or elongated bulb, which terminates posteriorly [aborally] in a relatively short and wide cylindrical tube [neck], standing well out of the body. The surface of these organisms is entirely covered by miniscule spines which, however, are lost with great ease, a statement made because the majority of the specimens prepared appear smooth, but an examination under

great magnification reveals the remnants of spines or their attachment scars that remain on the surface as small nodules. The spines in general are simple and only rarely are forms encountered that terminate in a bifurcation. These spines are relatively short, their length varying between  $1/10$  and  $1/20$  of the diameter of the body. The anterior region [body chamber] of the body is rounded and completely closed; the tube [neck] ends in a basal opening [mouth] whose margin varies between smooth and irregularly fringed. Some specimens have spines developed as far as this posterior margin which, nevertheless, may appear here accidentally by the posterior bending of the spines surrounding the margin of the opening [mouth]. The color of these fossils is black grading to dark amber in the basal region where the membrane is thinner and transparent. Almost all the specimens are flattened by compression, occurring, as a consequence, in slight variations of form which, nevertheless, are maintained within a certain limit and do not permit any specific differentiation.

*Remarks.* - The relationship of *Angochitina mourai* to *Angochitina globosa*, which it resembles, has been discussed in detail under remarks about that species. The spherical body chamber and spiny ornamentation of *mourai* (text fig. 7) are similar to those of *Angochitina echinata* Eisenack (1931), from the Baltic Silurian. However, *echinata* has a relatively long neck, resulting in a proportion of total length to width of body chamber of  $2.4/2.1:1$ , in contrast to the ratio of only  $1.5/1$  for *mourai*. Furthermore, the spines of *echinata* are about twice the length of those of *mourai*. Many of our specimens show distinct collars equal to about a fifth the total length of the test.

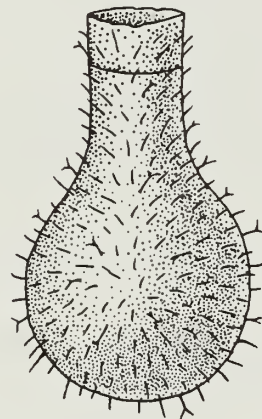


Fig. 7 - *Angochitina mourai* Lange showing characteristic shape and numerous short spines,  $\times 320$ .

*Occurrence.* - Uncommon in Cedar Valley limestone from Milan quarry. Originally described from the Middle Devonian Barreirinha shale, in the State of Parana', Brazil.

*Repository.* - Illinois State Geological Survey, 8P11-6, 8P18-42.

#### ANGOCHITINA n. sp.

##### Plate 1, figure 12

A single representative of an apparently new species was collected from bed five. The specimen is exceptionally long (0.339 mm.), has an ovoid body chamber and an unusually long neck. The ratio of over-all length/length of neck is 0.43 or

the same as for *Angochitina devonica* Eisenack. However, the maximum diameter is only one-fifth the length (dia./length = 0.22) whereas the average diameter of *devonica* averages half the length (dia./length = 0.5). The specimen exhibits scattered spine bases but no complete spines. No collar is discernible.

The specimen is reminiscent of *Lagenochitina avelinoi* Lange from the Middle Devonian of Brazil but that species bears no spines. *Angochitina elongata* Eisenack from the lower Paleozoic of the Baltic region of Europe is somewhat like it also, but *elongata* bears numerous fine spines and a flared collar.

*Occurrence.* - Bed five, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P23.

#### Genus ANCYROCHITINA Eisenack 1955

Type species: *Ancyrochitina ancyrea* (Eisenack)

As defined by Eisenack, this genus consists of relatively large forms having conical or, rarely, spherical body chambers; subcylindrical necks,  $1/2$  to  $2/3$  the total length of the specimen; and 4 to 10 strong, simple bifurcate or multibranching spines near the aboral end. The base of the body chamber may be either weakly concave or weakly convex. The type species is from the Silurian Choneteskalk of the Baltic region.

In 1955, Collinson and Schwalb proposed *Ampullachitina* for the same group of species for which Eisenack, earlier in the year, had proposed *Ancyrochitina*. Accordingly, *Ancyrochitina* Eisenack has precedence over *Ampullachitina* Collinson and Schwalb, and the latter should be considered a junior synonym.

#### ANCYROCHITINA CORNIGERA Collinson and Scott, n. sp.

Plate 2, figures 4, 5, 15-19

*Ancyrochitina cornigera* (text fig. 8) is one of the most distinctive forms in the Cedar Valley faunule, although it is common only in bed three of the outcrop. It is rare or absent in other samples. The conical body chamber of the species makes up a third to a half of the total length. The aboral end is flat or slightly concave. The maximum diameter is near the aboral end, which is ornamented with a few (commonly six) short, simple spines that may be straight or slightly curved. The body cavity extends into the spines. The neck is long, cylindrical, or slightly tapered orally and is surmounted by a short indistinct collar. The ratio of neck length/over-all length ranges from 0.36 to 0.50. In addition to the row of basal spines, the neck may bear one or two short, thick spines (pl. 2, fig. 16), otherwise the surface is smooth.

*Remarks.* - In over-all shape of test, and in distribution and shape of spines *cornigera* is similar to *Ancyrochitina diabolus* (Eisenack) from the Ordovician of the Baltic area. Two main differences distinguish these species. First, *diabolus* has a relatively long neck (the ratio of neck length/over-all length being greater than 0.5); secondly, there is a great difference in apical angle, *diabolus* ranging from  $50^{\circ}$  to  $80^{\circ}$ , *cornigera* from  $35^{\circ}$  to  $50^{\circ}$ .

*Ancyrochitina ancyrea* (Eisenack), the type species, is likewise similar to *cornigera* but possesses long, multibranched basal spines. Long, broad, basal spines and an exceptionally long neck serve to distinguish *Ancyrochitina fragilis* Eisenack from *cornigera*.

*Measurements.* - The following table represents in millimeters the dimensions of the holotype and paratypes. Measurements were made with a micrometer ocular.

| Specimen no.                   | 8P16-2* | 8P16-5* | 8P16-23* | 8P22-4* | 8P1-21 | 8P18-8 | 8P22-5 | Mean |
|--------------------------------|---------|---------|----------|---------|--------|--------|--------|------|
| Dimensions                     |         |         |          |         |        |        |        |      |
| Over-all length                | .199    | .167    | .181     | .199    | --     | .171   | .181   | .183 |
| Body chamber length            | .127    | .090    | .090     | .109    | --     | .090   | .081   | .098 |
| Neck length (w. collar)        | .072    | .077    | .091     | .090    | --     | .081   | .100   | .085 |
| Collar length                  | --      | .027    | .036     | .014    | --     | --     | .022   | .025 |
| Maximum spine length           | .018    | .022    | .009     | .032    | .036   | .014   | .027   | .023 |
| Body chamber width             | .109    | .104    | .104     | .090    | .109   | .114   | .104   | .105 |
| Neck width                     | .040    | .036    | .040     | .032    | .045   | .045   | .050   | .041 |
| Chamber apical angle           | 39°     | --      | 48°      | 41°     | --     | --     | --     | 43°  |
| neck length<br>over-all length | .36     | .46     | .5       | .45     | --     | .47    | .5     | .46  |

\* = holotype, • = paratype, -- = not measurable.

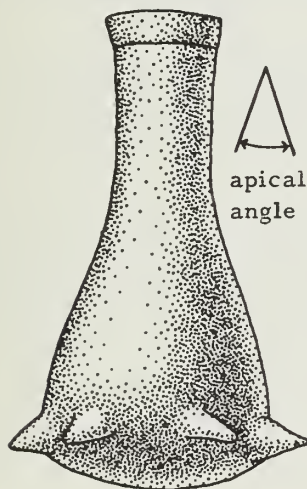


Fig. 8 - Diagrammatic representation of *Ancyrochitina cornigera* n. sp., showing basal spines. Apical angle is indicated.  $\times 320$ .

*Derivation of name.* - From Latin *corniger* meaning "horned."

*Occurrence.* - Common in bed three, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P16-2 (holotype), 8P1-21, 8P22-5, 8P18-8, 8P22-4, 8P16-23, 8P16-5 (paratypes).

ANCYROCHITINA MEGASTYLA  
Collinson and Scott, n. sp.

Plate 2, figures 1-3, 7

Although not common, this species is distinctive and easily identifiable. It is characterized by a subconical body chamber and a long cylindrical neck.

The chamber is terminated by a flat or slightly indented base that is expanded to form six rather broad, long, attenuate spines that contain extensions of the body chamber. In some specimens one or two

spines may not be fully developed. In individuals where spines project horizontally (pl. 2, fig. 3) they give the appearance of a scalloped basal flange. One or two short, coarse spines may occur on the upper part of the neck or collar, otherwise the surface is smooth. The chamber wall is moderately thick.

*Remarks.* - *Ancyrochitina megastyla* is closely related to *Ancyrochitina cornigera*, with which it occurs. They may be readily differentiated, however, in that *megastyla* possesses broad attenuate spines and *cornigera* has spike-like spines of circular cross section (text fig. 9). They also differ in neck length/over-all length ratios; *cornigera* ranges between 0.36 and 0.50 whereas *megastyla* gives ratios greater than 0.55. Like *cornigera*, *megastyla* is similar to both *Ancyrochitina ancyrea* and *Ancyrochitina diabolo*, but *megastyla* has a smaller apical angle than *diabolo* and does not have bifurcate spines like *ancyrea*.

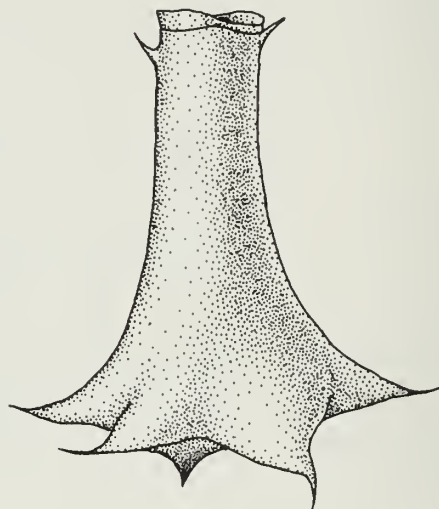


Fig. 9 - Diagram of *Ancyrochitina megastyla* n. sp. showing neck spines and the characteristic broad attenuate basal spines,  $\times 300$ .

*Measurements.* - The following dimensions given in millimeters were measured with a micrometer ocular.

*Holotype:* over-all length .181, body length .072, neck length .109, collar length, .022, max. spine length .036, body dia. .109, neck dia. .032, apical angle  $45^\circ$ .

*Paratype:* over-all length .208, body length .059, neck length .118, collar length .022, max. spine length .014, body dia. .162, neck dia. .045, apical angle  $49^\circ$ .

*Derivation of name.* - From Latin *megastylus*, meaning "having large spines."

*Occurrence.* - Uncommon in bed three and rare in bed five, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P1-24 (holotype), 8P10-51, 8P17-24, 8P22-49 (paratypes).

Genus SPHAEROCHITINA Eisenack 1955

Type species: *Sphaerochitina sphaerocephala* (Eisenack)

This genus was proposed by Eisenack for forms with subcylindrical necks; cone-, sphere-, or broadly mushroom-shaped body chambers; and essentially smooth

walls that bear tiny tubercles or small, thick, erect spinules. The type species originally was described from the Silurian Beyrichienkalk of the Baltic region.

SPHAEROCHITINA PILOSA Collinson and Scott, n. sp.

Plate 3, figures 1-5

This species occurs in greater numbers than any other in the Cedar Valley faunule. Its general shape is that of a long-necked erlenmeyer flask (text fig. 10).

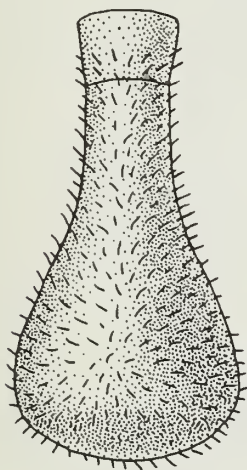


Fig. 10 - Diagrammatic representation of *Sphaerochitina pilosa* n. sp. showing typical shape of test and distribution of short spines,  $\times 300$ .

The conical body chamber has its greatest diameter very near the aboral end. The apical angle averages  $53^\circ$ . The neck is distinct, cylindrical, slightly shorter than the body chamber, and terminated orally by a short, slightly flared translucent collar. Aborally the test is terminated by a flat to slightly convex base. The wall of the test is only moderately thick and ornamented with numerous, close-set, very fine spines. Some specimens denuded of spines appear to be smooth, although a careful inspection reveals the spine bases.

*Remarks.* - Several species have the same shape as *Sphaerochitina pilosa*. Of these, *Ancyrochitina ancyrea* (Eisenack), *Ancyrochitina diablo* (Eisenack), *Ancyrochitina laguncula* (Collinson and Schwalb) and *Ancyrochitina spinosa* (Eisenack) can

be readily differentiated by gross differences in spine ornamentation. However, two species have been described that have no external ornamentation and therefore might be confused with denuded representatives of *Sphaerochitina pilosa*. The first of these, *Sphaerochitina fungiformis* (Eisenack), has a neck twice as long as the body chamber and can be distinguished from *pilosa* by that means. The second, *Sphaerochitina sphaerocephala* Eisenack, may be distinguished by its well rounded base.

*Measurements.* - Dimensions for *Sphaerochitina pilosa* are given in table 1.

*Derivation of name.* - From Latin *pilosus*, meaning "hairy."

*Occurrence.* - Very abundant in bed three, common in bed five, occurs in beds four and six, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P1-25 (holotype), 8P25-24, 8P22-51, 8P17-3, 8P25-3 (all paratypes).

Table 1. - Measurements of Type Specimens  
(In millimeters)

| Species           |  | <i>Sphaerochitina pilosa</i> |        |         |        |         |      | <i>Sphaerochitina schwalbi</i> |          |         |        |      |        | <i>Sphaerochitina nodulosa</i> |          |         |      |  |  |
|-------------------|--|------------------------------|--------|---------|--------|---------|------|--------------------------------|----------|---------|--------|------|--------|--------------------------------|----------|---------|------|--|--|
| Specimen no.      |  | 8P1-25*                      | 8P17-3 | 8P22-51 | 8P25-3 | 8P25-24 | Mean | 8P2-24                         | 8P13-31* | 8P18-52 | 8P22-6 | Mean | 8P1-23 | 8P16-21a                       | 8P16-21b | 8P18-3* | Mean |  |  |
| Dimensions        |  |                              |        |         |        |         |      |                                |          |         |        |      |        |                                |          |         |      |  |  |
| Over-all length   |  | .190                         | .176   | .186    | .181   | .181    | .183 | .144                           | .141     | .118    | .144   | .137 | .181   | .162                           | .181     | .154    | .170 |  |  |
| Body length       |  | .090                         | .080   | .095    | .090   | .118    | .095 | .088                           | .090     | .081    | .086   | .089 | .104   | .086                           | .105     | .082    | .094 |  |  |
| Neck length       |  | .100                         | .090   | .091    | .090   | .063    | .087 | .056                           | .051     | .037    | .058   | .051 | .077   | .076                           | .086     | .072    | .078 |  |  |
| Collar length     |  | .032                         | .027   | .040    | .018   | .032    | .030 | .032                           | .009     | .018    | .034   | .023 | .027   | .032                           | .027     | .018    | .026 |  |  |
| Max. spine length |  | .005                         | .003   | .002    | .003   | .005    | .004 | --                             | .005     | --      | --     | --   | .003   | .007                           | .005     | .004    | .005 |  |  |
| Body diameter     |  | .095                         | .090   | .109    | .090   | .100    | .097 | .104                           | .111     | .104    | .090   | .102 | .090   | .090                           | .104     | .100    | .099 |  |  |
| Neck diameter     |  | .032                         | .032   | .032    | .027   | .027    | .030 | .036                           | .038     | .036    | .036   | .037 | .036   | .032                           | .032     | .040    | .035 |  |  |
| Apical angle      |  | 50°                          | 45°    | 60°     | 55°    | 52°     | 53°  | 74°                            | 77°      | 76°     | 67°    | 74°  | 42°    | 54°                            | 55°      | 53°     | 51°  |  |  |

\* = holotype. All other specimens are paratypes. -- = not measurable. Measurements by means of a micrometer ocular.

\* = holotype. All other specimens are paratypes. -- = not measurable.

Measurements by means of a micrometer ocular.

## SPHAEROCHITINA SCHWALBI Collinson and Scott, n. sp.

Plate 3, figures 6-10

Although not as abundant as *Sphaerochitina pilosa*, which it resembles, this species is common in most Cedar Valley samples. Its test, shaped like a short-necked erlenmeyer flask, has a conical body chamber with maximum diameter near the broad, slightly convex base. The sides of the chamber slope orad to form an apical angle of  $75^{\circ}$  to  $80^{\circ}$  and are quite distinct from the short cylindrical neck which is terminated orally by a short, transparent collar. The average ratio of neck length to over-all length is 0.35. With the exception of the collar, the entire surface of the test is densely covered by numerous very short simple spines (text fig. 11). Where these spines are broken, the spine bases impart a roughened texture to the surface.

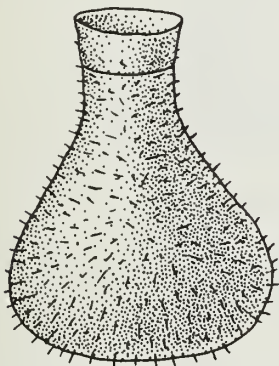


Fig. 11 - Diagrammatic representation of *Sphaerochitina schwalbi* n. sp. showing characteristic short neck and short spines,  $\times 350$ .

*Remarks.* - This species is closely related to *Sphaerochitina pilosa*, with which it occurs, but may be distinguished from it by the much shorter neck. The specimen illustrated on plate 3, figure 3, suggests transition between the two species. However, most specimens can be referred clearly to one or the other.

The relatively broad base distinguishes *schwalbi* from other short-necked, erlenmeyer-flask-like forms bearing simple spines (for example, *Conochitina cactacea* Eisenack). The ratio of the total width to total length of *schwalbi* is 5:7, but in *cactacea* it is only about 1:2.

*Measurements.* - Dimensions for *Sphaerochitina schwalbi* are given in table 1.

*Derivation of name.* - In honor of Howard Schwalb for his contribution to the study of Illinois chitinozoans.

*Occurrence.* - Common in beds three through six, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P13-31 (holotype), 8P22-6, 8P2-24, 8P15-6, 8P18-52 (all paratypes).

## SPHAEROCHITINA NODULOSA Collinson and Scott, n. sp..

Plate 3, figures 15-19, 23, 25

The identifying characteristic of this very common species is its ornamentation, which consists of a few irregularly scattered, short, thornlike spines or rounded nodes confined to the aboral end of the body chamber. With this exception the test is

generally smooth. A few specimens bearing spines on the neck (for example, plate 3, fig. 18) have been observed. The test is shaped like an erlenmeyer flask with a gently convex aboral end and a conical body chamber that tapers gradually into the subcylindrical neck (fig. 12).

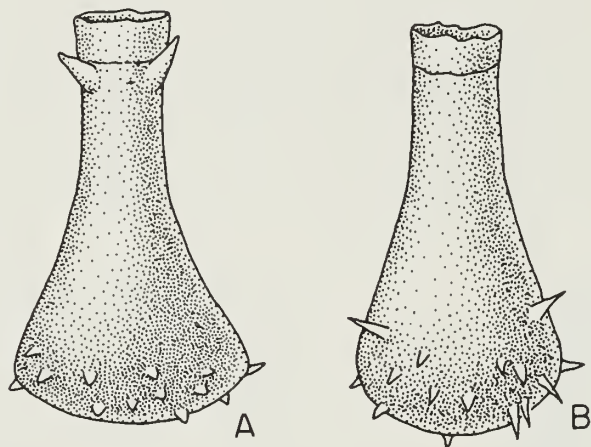


Fig. 12 - Diagrammatic representations of (A) *Sphaerochitina nodulosa* n. sp. showing distribution of spines and nodes; (B) *Sphaerochitina* cf. *S. nodulosa* illustrating thornlike spines and small apical angle. Both  $\times 320$ .

*Remarks.* - In general form, *Sphaerochitina nodulosa* is similar to several other species, but in every case it may be distinguished by the nature and distribution of its spines: *Sphaerochitina pilosa* and *Ancyrochitina cactacea* (Eisenack) have spines on the oral half of the test; *Ancyrochitina fragilis* Eisenack, *Ancyrochitina diabolo* (Eisenack) and *Ancyrochitina ancyrea* (Eisenack) all have filamentous or branching spines near the maximum diameter; spines are lacking entirely in *Sphaerochitina sphaerocephala* (Eisenack) and *Sphaerochitina fungiformis* (Eisenack).

The generic assignment of this species is not certain. Eisenack (1955) proposed the genus *Sphaerochitina* to include forms that are smooth, have only tiny tubercles, or very thick, erect, very small spinules. We believe that *nodulosa* fits into this category because of its nodular ornamentation. Only a few specimens having large spines have been observed.

*Measurements.* - Dimensions for *Sphaerochitina nodulosa* are given in table 1.

*Derivation of name.* - From the Latin *nodulosus* meaning "full of little nodes."

*Occurrence.* - Common in bed three, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P18-3 (holotype), 8P16-21b, 8P16-21a, 8P1-23 (paratypes).

## SPHAEROCHITINA cf. S. NODULOSA Collinson and Scott

Plate 3, figures 12, 14

Two well preserved specimens in our collections closely resemble *Sphaerochitina nodulosa* but differ from *nodulosa* in that the apical angle is much smaller ( $41^\circ$  and  $44^\circ$ ), the body chamber is correspondingly longer (ratio of neck length/over-all length = 0.63, pl. 3, fig. 14), and it possesses thornlike spines rather than nodes. We are not certain whether these differences represent specific variation, or are significant enough to warrant erection of a new species. In either case, study of additional material will be necessary before a decision can be made.

*Occurrence.* - Bed three, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P1-44, 8P1-23.

Genus EARLACHITINA Collinson and Scott, n. gen.

Type species: *Earlachitina latipes* Collinson and Scott, n. sp.

Our collections from the Cedar Valley formation contain a group of specimens sufficiently different from any previously described to warrant erection of a new genus.

*Earlachitina* is proposed to include forms that are characterized by depressed subconical to subdiscoidal body chambers and subcylindrical necks terminated orally by a simple aperture. Specimens may or may not be collared. The base of the body chamber may be either slightly convex or concave and its periphery is ornamented by a variable number of spines formed by prolongations of the body wall. A few spines may also be present on the neck and collar, otherwise, the surface of the test is smooth.

The name is given in honor of Earl A. Collinson of the Collinson Stone Company which operates Milan quarry. Mr. Collinson, foster father of the senior author, accompanied him on collecting trips to the quarry and showed great interest in the project.

EARLACHITINA LATIPES Collinson and Scott, n. gen., n. sp.

Plate 2, figures 8, 9, 12-14, 20-24; plate 3, figures 13, 24

The distinctive subdiscoidal body chamber of *Earlachitina latipes* (text fig. 13) expands rapidly aborally forming a kind of flange referred to as the "aboral brim." Two to six (most commonly five or six) broad spines of variable length and development ornament the periphery of the brim. These are formed by the local projection of the body wall and contain extensions of the body chamber. The base of the body chamber is slightly concave. Orally the chamber tapers very rapidly from the brim. The apical angle is exceptionally large and ranges from  $80^\circ$  to  $110^\circ$ . The average chamber diameter is 0.112 mm.; the average over-all length only 0.054 mm. The juncture of chamber and neck is variable. In some specimens (pl. 2, fig. 8) the chamber tapers gradually into the neck, but in others (pl. 2, fig. 20) the juncture may

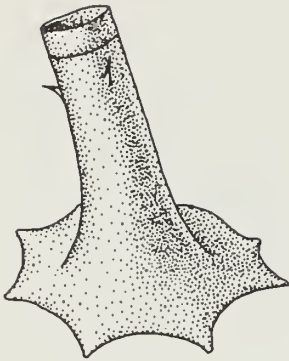


Fig. 13 - Diagrammatic representation of *Earlachitina latipes* n. gen., n. sp. showing neck spines, collar, brim and basal spines,  $\times 365$ .

be quite distinct. The neck is relatively long and subcylindrical to cylindrical and is terminated orally by a short, thin, translucent collar. The moderately thick chamber wall is smooth with the exception of one or two short, stout spines that may be present on the collar or neck.

*Remarks.* - This species is not closely similar to any previously described forms. It is similar to the specimens figured on plate 2, figures 6 and 10 as *Earlachitina* n. spp., but the latter differ in being smaller without definite brims and in possessing relatively small indistinct spines.

*Measurements.* - The following dimensions are in millimeters and were determined with a micrometer ocular.

| Specimen no.            | 8P14-11b* | 8P22-23* | 8P21-1* | 8P22-49* | 8P16-3* | 8P1-2* | 8P22-32* | Mean |
|-------------------------|-----------|----------|---------|----------|---------|--------|----------|------|
| Over-all length         | .131      | .118     | .118    | .127     | .167    | .109   | .144     | .131 |
| Body chamber length     | .054      | .054     | .054    | .054     | .050    | .063   | .054     | .057 |
| Neck length (w. collar) | .077      | .064     | .064    | .073     | .117    | .046   | .090     | .076 |
| Collar length           | --        | .014     | .022    | .014     | .022    | --     | .014     | .016 |
| Maximum spine length    | .018      | .014     | .027    | .005     | .027    | .032   | .014     | .019 |
| Body chamber diameter   | .127      | .109     | .127    | .114     | .109    | .090   | .109     | .112 |
| Neck diameter (average) | .032      | .032     | .032    | .027     | .032    | .032   | .036     | .032 |

\* = holotype, • = paratypes, -- = not measurable.

*Derivation of name.* - From the Latin *latipes*, meaning "broad-footed."

*Occurrence.* - Common in bed three and rather uncommon in beds five and eight, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P16-3 (holotype), 8P14-11b, 8P22-23, 8P21-1, 8P22-49, 8P1-2, 8P22-32 (all paratypes).

EARLACHITINA n. spp.

Plate 2, figures 6, 10, 11

Several specimens among our collections seem to be referable to two new species but, due to the lack of well preserved material, detailed descriptions are not justified. The one group, illustrated by figures 6 and 10 on plate 2, consists of small individuals with depressed conical chambers, flat bases, cylindrical necks,

and short collars. The spines about the peripheral edge of the chamber are rather poorly developed. The second group, illustrated by figure 11 on plate 2, has sub-conical chambers much like those of some representatives of *Earlachitina latipes*, but the aboral brim is not as strongly developed and the spines are very small and numerous.

*Occurrence.* - Rare in bed three, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - Illinois State Geological Survey, 8P22-12, 8P22-50 and 8P16-8.

#### CYSTS?

##### Plate 3, figure 21

Among our collections there are about half a dozen black spherical bodies that are about 0.10 mm. in diameter and appear to consist of the same material as our chitinozoans. We are at a loss to explain the zoological affinities of these bodies, although they may possibly represent an encysted stage of Chitinozoa.

*Occurrence.* - Beds five and three, Solon member, Cedar Valley formation, near Milan, Illinois.

*Repository.* - 8P18-46 (figured specimen).

## EXPLANATION OF PLATE 1

All illustrations are camera lucida drawings of specimens magnified  $\times 175$ . Numbers in parentheses refer to the specimen number.

Figs. 1-5, 7, 8, 19, 26. - *Angochitina milanensis* Collinson and Scott, n. sp. 1, a perfectly preserved paratype (8P14a) showing numerous broad-based spines; 2, the holotype (8P14-23); 3-5, 7, 8, 26, paratypes (8P24-1, 8P13-3, 8P12-32, 8P25-30, 8P6, 8P2-25, respectively) illustrating spines and combination in which they occur; 19, a paratype (8P1-44) possessing a relatively long collar.

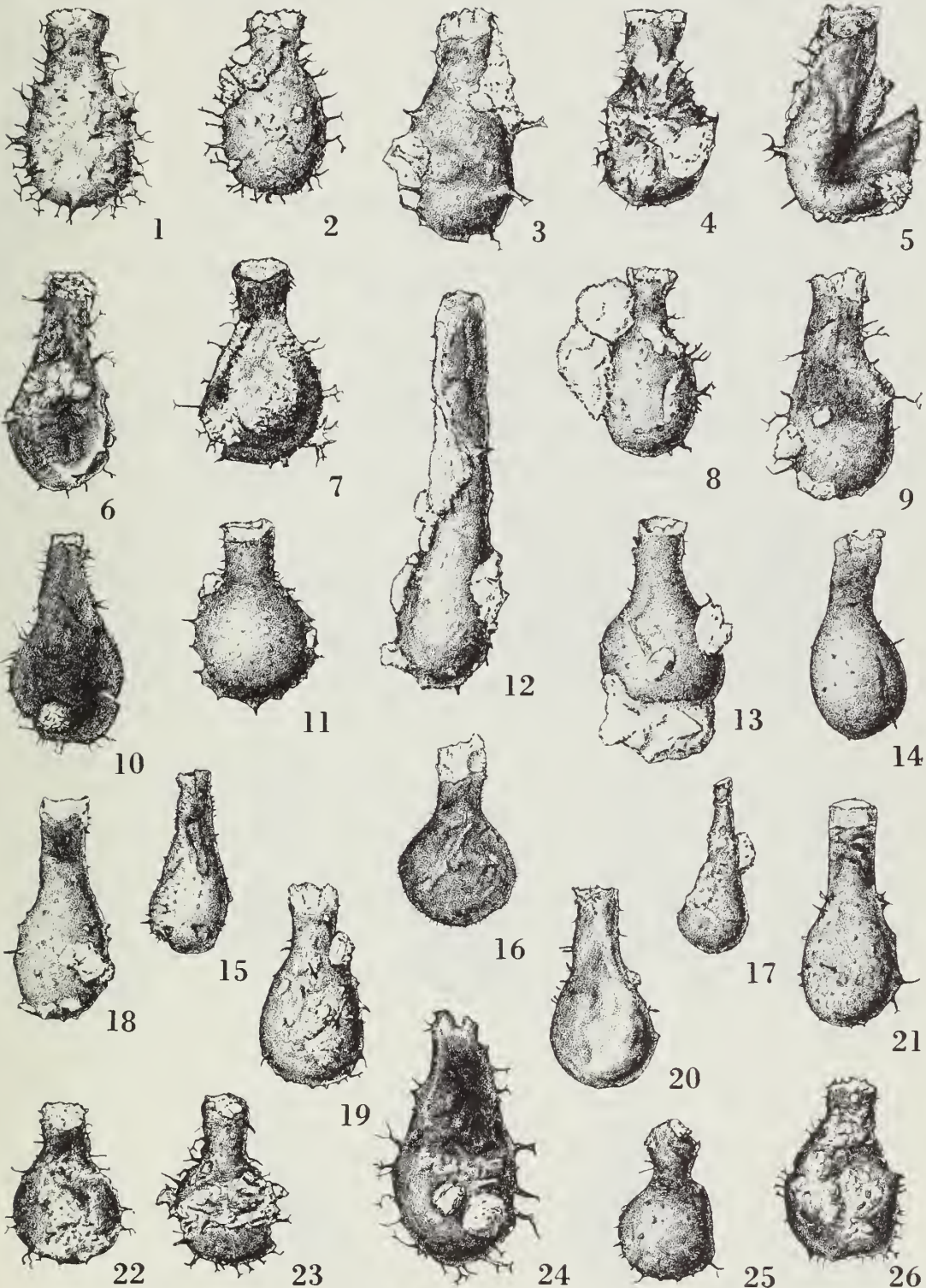
Figs. 6, 9, 10, 14, 18, 20, 21, 24. - *Angochitina devonica* Eisenack. 6, 9, well preserved specimens (8P7, 8P25-12) showing characteristic spinosity; 10, a flattened specimen (8P1-2) possessing an unusually narrow neck; 14, 18, 20, (8P11-48, 8P1-2, 8P24-44, respectively) specimens illustrating the common state of preservation; 21, a specimen (8P1-44) possessing an exceptionally well preserved collar; 24, a large specimen (8P11-21a) with numerous robust spines.

Figs. 11, 13, 22, 23, 25. - *Angochitina globosa* Collinson and Scott, n. sp. 11, 13, 25, well preserved paratypes (8P1-22, 8P20-1, 8P25-7, respectively); 22, the holotype (8P1-23), which is laterally compressed, showing simple, bifurcate, and multibranched spines and a well preserved collar; 23, a laterally compressed paratype (8P13-2) showing the characteristic combination of spines.

Fig. 12. - *Angochitina* n. sp. An unusually large specimen (8P23) with long neck and scattered spine bases.

Figs. 15, 17. - *Angochitina* cf. *A. devonica* Eisenack. Small tapered specimens (8P2-26, 8P18-5) with indistinguishable necks showing scattered spine bases.

Fig. 16. - *Angochitina mourai* Lange. A crushed but otherwise perfectly preserved specimen (8P11-6) with numerous simple spines and relatively long collar.



## EXPLANATION OF PLATE 2

All illustrations are camera lucida drawings of specimens magnified  $\times 175$ . Numbers in parentheses refer to the specimen number.

Figs. 1-3, 7. - *Ancyrochitina megastyla* Collinson and Scott, n. sp. 1, the holotype (8P1-24), a perfectly preserved specimen showing basal and neck spines as well as collar; 2, 7, paratypes (8P10-51, 8P22-49) showing common type of preservation; 3, a large paratype (8P17-24) with ends of spines broken off.

Figs. 4, 5, 15-19. - *Ancyrochitina cornigera* Collinson and Scott, n. sp. 4, a distorted paratype (8P1-21) showing six basal spines; 5, an incomplete paratype (8P22-5) showing collar and spines; 15, 19, crushed paratypes (8P18-8, 8P16-5) illustrating common state of preservation; 16, paratype (8P22-4) exhibiting collar and neck spine; 17, 18, paratype (8P16-23) and holotype (8P16-2) in nearly perfect state of preservation.

Figs. 6, 10, 11. - *Earlachitina* n. spp. 6, 10, two small short-necked specimens (8P22-12, 8P22-50) possessing collars; 11, an incomplete specimen (8P16-8) showing narrow basal flange and small broad spines.

Figs. 8, 9, 12-14, 20-24. - *Earlachitina latipes* Collinson and Scott, n. sp. 8, a well preserved paratype (8P1-2); 9, 12, 13, paratypes (8P22-11, 8P18-48, 8P16-25, respectively) illustrating variations of arrangement and shape of basal spines; 14, a crushed paratype (8P22-32) bearing only four spines; 20, a well preserved but collarless paratype (8P22-23) showing only three spines; 21, a nearly perfectly preserved paratype (8P14-11b) exhibiting a collar and neck spines; 22, a paratype (8P18-32) bearing six spines; 23, a distorted specimen (8P22-49) illustrating the common type of preservation; 24, the holotype (8P16-3), a nearly perfectly preserved specimen.



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## EXPLANATION OF PLATE 3

All illustrations are camera lucida drawings of specimens magnified  $\times 175$ . Numbers in parentheses refer to the specimen number.

Figs. 1-5. - *Sphaerochitina pilosa* Collinson and Scott, n. sp. 1, 3-5, well preserved paratypes (8P25-24, 8P22-51, 8P17-3, 8P25-3, respectively) showing variation in form, spine distribution and preservation; 2, the holotype (8P1-25) with spines perfectly preserved. A sand grain adheres to the collar.

Figs. 6-10. - *Sphaerochitina schwalbi* Collinson and Scott, n. sp. 6, 7, 9, 10, paratypes (8P2-24, 8P22-6, 8P15-6, 8P18-52, respectively) illustrating variation in preservation and form; 8, the holotype (8P13-31) with part of the collar missing but showing typical form and excellent spine preservation.

Fig. 11. - *Angochitina mourai* Lange. A flattened specimen (8P18-42) retaining a few simple spines.

Figs. 12, 14. - *Sphaerochitina* cf. *S. nodulosa* Collinson and Scott. 12, incomplete specimen (8P1-44) exhibiting few spines but numerous spine bases; 14, a nearly perfect specimen (8P1-23) showing small apical angle, elongate chamber, and thornlike spines. A sand grain adheres to the neck.

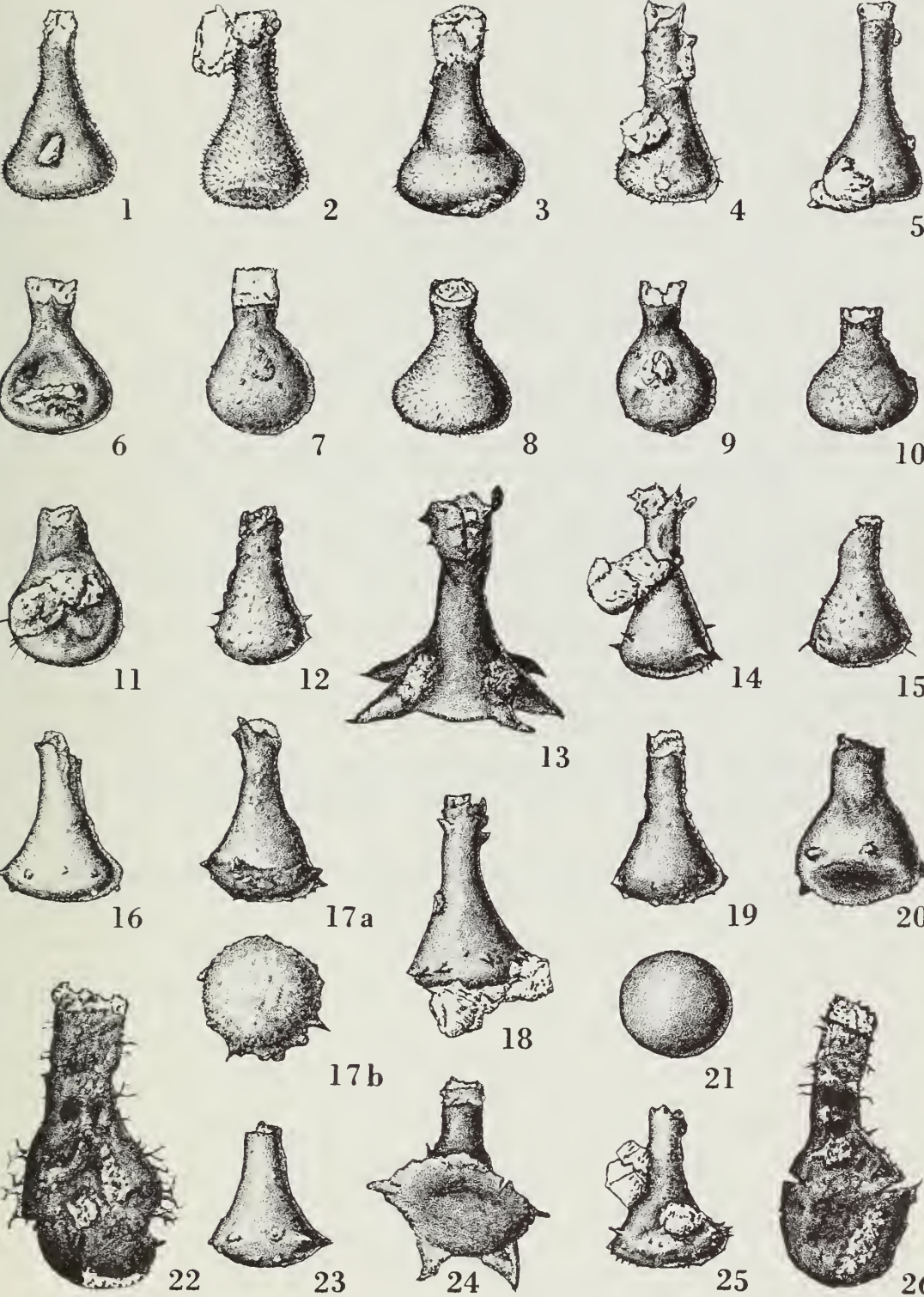
Figs. 13, 24. - *Earylachitina latipes* Collinson and Scott, n. gen., n. sp. 13, a large paratype (8P21-7) exhibiting unusually large spines on the body chamber; 24, a paratype (8P21-1) showing the slightly concave base characteristic of the species.

Figs. 15-19, 23, 25. - *Sphaerochitina nodulosa* Collinson and Scott, n. sp. 15, 16, 19, 23, 25, paratypes (8P17-30, 8P20-4, 8P16-21, 8P16-32, 8P1-41, respectively) showing variations in preservation, spine and node distribution, and body chamber shape; 17a, 17b, lateral and basal views of the holotype (8P18-3) illustrating shape and distribution of spines and nodes; 18, a very well preserved paratype (8P16-21) showing short spines about the body chamber and on the neck.

Fig. 20. - *Ancyrochitina cornigera* Collinson and Scott, n. sp. An incomplete paratype (8P22-21) illustrating the flat basal end.

Fig. 21. - Cyst?

Figs. 22, 26. - *Angochitina devonica* Eisenack. Two large specimens (8P11-10, 8P10-43).



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Illinois State Geological Survey Circular 247  
34 p., 3 plates, 13 text figs., 1 table, 1958



CIRCULAR 247

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